5.8 WEATHER

Weather is determined by four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet. Certain combinations can produce severe weather events that could potentially create primary, secondary, and even tertiary disasters.

Weather events cause the majority of Alaska's disasters. Wind-driven waves from intense storms crossing the Bering Sea produce coastal flooding and can drive large chunks of sea ice inland destroying buildings near the shore. High winds, especially across Alaska's Arctic coast, can combine with loose snow to produce a blinding blizzard and wind chill temperatures to 75°F below zero. Extreme cold (-40°F to -60°F) and ice fog may last a week at a time. Heavy snow can impact the interior and is common along the southern coast. Heavy snow accumulation in the mountains builds glaciers, but can also cause avalanches or collapse building roofs throughout the State. A quick thaw means certain flooding.

Hazard Analysis/Characterization

Winter Storms

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Moisture - The air must contain moisture in order to form clouds and precipitation.
- Cold air - Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and/or near the ground to make snow and/or ice.
- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:
    - The flow of air up a mountainside.
    - Fronts, where warm air collides with cold air and rises over the dome of cold air.
    - Upper-level low pressure troughs.

Snow Terminology

Heavy Snow generally means:
- Snowfall accumulating to 4 inches or more in depth in 12 hours or less
- Snowfall accumulating to 6 inches or more in depth in 24 hours or less

Snow Squalls are periods of moderate to heavy snowfall, intense, but limited duration, accompanied by strong, gusty surface winds and possibly lightning.

A Snow Shower is a moderate snowfall lasting a short duration.

Snow Flurries are an intermittent light snowfall lasting a short duration with no measurable accumulation.

Blowing Snow is wind-driven snow that reduces surface visibility and can be falling snow or already accumulated but is picked up and blown by strong winds.

Drifting Snow is an uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

A Blizzard means that the following conditions are expected to prevail for 3 hours or longer:
- Sustained wind or frequent gusts to 35 miles/hour or greater
- Considerable falling and/or blowing snow reducing visibility to less than 1/4 mile
- Freezing Rain or Drizzle occurs when rain or drizzle freezes on surfaces such as the ground, trees, power lines, motor vehicles, streets, highways, etc.

A series of severe winter storms in December 1999 and January 2000 triggered avalanches and flooding in Southcentral Alaska and resulted in a Federal Disaster Declaration. The Municipality of Anchorage, the Kenai Peninsula Borough, the Matanuska-Susitna Borough, and the Valdez-Cordova census area received funding to supplement the governments' recovery needs to pay for debris removal, emergency services, and repair and replacement costs for damaged public facilities related to the storms.

Heavy Snow

Heavy snow, generally more than an accumulation of 12 inches in less than 24 hours, can immobilize a community by bringing transportation to a halt. Airports and major roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services until the snow can be removed. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage parked light aircraft and sink small boats. Heavy snow can lead to avalanches in the mountains. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. Snow removal, damage repairs, and business loss costs can have severe economic impacts on cities and towns.

Heavy snow in Kotzebue after a blizzard in April 2001
Image courtesy of the NWS, Kotzebue office

Heavy snow can cause vehicle accidents, injuries, and even deaths. Overexertion while shoveling snow and hypothermia from overexposure to cold weather often cause casualties winter injuries.

Heavy snow can impact interior Alaska, but it is most common along the southern coasts. Alaska's weather is greatly influenced by large high pressure areas that can persist for weeks at a time over Siberia, interior Alaska, and northwestern Canada. Storms crossing the North Pacific often move into the Gulf of Alaska dumping large amounts of precipitation over the southern coastal region while a well-developed mass of cold air dominates the interior. The most frequent heavy snowfalls occur along the north Gulf coast from Prince William Sound to the southeastern Panhandle. One to two feet snowfalls are common in coastal communities such as Valdez and Yakutat, and these same events can bring up to six feet of snow to the nearby mountains. For example, the mountain ranges near Glacier Bay and Thompson Pass are considered two of the snowiest place in the nation.

Snow at the Kotzebue NWS office
Image courtesy of the NWS, Kotzebue office

High winds, especially across the Arctic coast, can combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures.

Over 147 inches of snow fell in Yakutat over a 22-day period from January 23 – February 14, 1999. The snow weight caused roofs to collapse on four buildings and caused minor damage to a number of homes and vehicles. The snow depth increased so much over such a short time period that even highway snow plows were temporarily stuck. The large snow volume seriously tapped local government's resources while trying to keep the roadways and the airport open.

NWS housing in Yakutat after a heavy snowfall
Image courtesy of the NWS Yakutat office

Record heavy snow occurred in Anchorage on March 17, 2002 when two to three feet of snow fell in less than 24 hours over portions of the city. Ted Stevens International Airport recorded a storm total of 28.7 inches, and an observer measured over 33 inches near Lake Hood. The Municipality of Anchorage was essentially shut down during the storm, which fortunately occurred on a Sunday morning when a minimal number of businesses were open. Military bases, universities, and many businesses remained closed the following day; Anchorage schools remained closed for two days. It took four days for snow plows to reach all areas of the city.

It doesn't take several feet of snow to cause considerable risk to Anchorage area residents. More than 100 vehicle accidents occurred in the Anchorage-Eagle River area when 8 to 12 inches of snow fell on March 20, 2001.

Nearly a foot of snow fell over the City of Kodiak on March 23, 2001 followed by heavy rains and high winds causing approximately $25,000. The combination of snow, ice, and rain created treacherous driving conditions and contributed to a number of accidents. Nine transformers failed during the storm, power lines came down all over the island, and a tree smashed a house damaging the roof. A 93 mph wind gust was measured at the Zachor Bay Lodge near Larsen Bay at the height of the storm.

Extreme cold

Generally the risk of extreme cold is restricted to the interior region of Alaska, bounded by the Alaska Range to the south and the Brooks Range to the north. Excessively cold temperature definitions vary according to the normal climate of a region. Near freezing temperatures are considered "extreme cold." in areas unaccustomed to winter weather. Extreme cold usually involves temperatures below –40 degrees Fahrenheit in Alaska. “Excessive cold” may accompany winter storms, be left in their wake, or can occur without storm activity.

Frostbite: damage caused when body tissue freezes, associated with feeling loss and a white or pale appearance in the extremities.

Hypothermia: is low body temperature. Normal body temperature is 98.6ºF. Seek immediate medical help when body temperature drops to 95ºF. Hypothermia also can occur with prolonged exposure to temperatures above freezing.

Extreme cold can bring transportation to a halt across interior Alaska for days or sometimes weeks at a time. Aircraft may be grounded due to extreme cold and ice fog conditions; cutting off access as well as the flow of supplies northern villages. Long cold spells can cause rivers to freeze disrupting shipping and increasing the likelihood of ice jams and associated flooding.

Extreme cold also interferes with a community’s infrastructure. It causes fuel to congeal in storage tanks and supply lines, stopping electric generation. Water and sewer pipes freeze or rupture when water heaters do not work or when electricity fails. The ground’s frost depth can increase freezing buried pipes if extreme cold conditions are combined with low or no snow cover.

The greatest danger from extreme cold is its effect on people. Infants and elderly people are most susceptible to prolonged cold exposure as frostbite or hypothermia can become life-threatening. Carbon monoxide poisoning greatly increases during episodes of extreme cold as people gravitate to alternate heating sources with insufficient venting.

A fairly widespread extreme cold event occurred across the interior part of the state during January 1989. The city of Fairbanks came to a virtual halt for fourteen days when bitter cold and ice fog gripped the area. Tanana recorded a low temperature of –76 °F, McGrath followed closely with –75°F, and the record for the highest barometric pressure reading ever recorded in North America occurred in the Village of Northway at 31.85 inches of mercury. Aircraft were grounded for more than 6 days during the event.

Ice Storms

The term ice storm is used to describe occasions when damaging ice accumulations are expected during freezing rain situations. They can be the most devastating winter weather phenomena and are often cause automobile accidents, power outages, and personal injury. Ice storms result when rain becomes super cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy snow accumulation and sleet in other locations.

Freezing rain develops as falling snow encounters a deep layer of warm air in the atmosphere sufficient enough for the snow to completely melt and become rain. As the rain passes through a thin layer of cold air just above the earth's surface it cools to below freezing. The drops themselves do not freeze, but rather they become super cooled. The rain drops then instantly freeze when they strike the frozen ground, power lines, tree branches, etc.

The atmospheric conditions that can lead to ice storms occur most frequently in Southwestern Alaska along the Alaska Peninsula and around Cook Inlet. Brief but frequent freezing rain instances occur along the southern coast of Alaska, but these events generally produce very light precipitation with less than ¼ inch of ice accumulation.

Freezing drizzle occurred in the local Juneau area for nearly 52 hours from January 18 – 20, 2000. Roadways became extremely icy and a number of automobile accidents occurred due to the long duration of the event even though the precipitation was very light. The freezing drizzle also created hazardous aircraft icing conditions in the area from the surface to about 2,500 meters (8,000 feet) above ground level (AGL).

On January 24, 2000 an ice storm occurred in Naknek when a frontal system associated with a strong low pressure system in the Bering Sea stalled over western Alaska. Lines were down area wide as Naknek Electrical Association estimated 1 to 2 inches of ice accumulation on power line conductors. Gale force winds and wet snow periods also impacted the area before the storm abated.

Aufeis

Aufeis, sometimes called glaciation or icing, forms when emerging ground water freezes in successive sheets until the ice is quite thick and covers a large area. Most are a few hundred yards long but can cover several square miles. They are usually two or three feet thick but can reach 30 feet or more.

Aufeis usually forms in winter and melts in summer. The conditions that lead to aufeis development are:

- Presence of groundwater moving down slope, especially above the permafrost table.
- Cold air temperatures and thin snow cover during the early winter.
- A layer of seasonally frozen ground.
- Thick snow cover in the late winter.

There are two main types: seepage and stream. Seepage aufeis is ice sheets that form from any source of seepage water on the surfaces of slopes or flatlands and are not associated with a creek or river. For example, aufeis can occur when artesian wells flow out of control or where water seeps onto a roadway because the roadway was cut into the hillside.

Stream aufeis can form on floodplains or surfaces of low stream terraces by water confined to stream valleys. Development starts when a shallow part of the stream freezes to the streambed. Upstream water is then backed up and seeps through fissures to form thin sheets of ice over the existing ice.

Aufeis is a significant problem for railroads and highways as it causes traffic problems and increased maintenance costs. The Steese Highway frequently has aufeis problems in the winter months.

Aufeis can occur in many parts of the State with the Fairbanks area facing a significant threat. This area has a history of aufeis related problems. For example, in winter of 1975-76 where Plack Road crosses the Chena Slough experienced a significant but relatively localized event. The channel of the Chena Slough had filled with ice, forcing water out of the banks and extending the aufeis area. As a result, the ice inundated the lower level of a nearby home burying bikes, tables, etc. to about three feet deep.

High Winds

High winds (winds in excess of 60 mph) occur rather frequently over the coastal areas along the Bering Sea and the Gulf of Alaska because of coastal storms. High winds, especially across the Arctic coast, can also combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures.

They can reach hurricane force and have the potential to seriously damage port facilities, the fishing industry, and community infrastructure (especially above ground utility lines).

Down slope wind storms created by temperature and pressure differences across the terrain can produce winds in excess of 100 mph especially in mountainous areas like the Coast Mountains and the Alaska Range. These wind storms can be particularly damaging as they are very gusty and may seem to come from several directions.

Localized downdrafts, downbursts & microbursts, are also important in Alaska. Downbursts and microbursts can be generated by thunderstorms. Downburst winds are strong concentrated straight-line winds created by falling rain and sinking air that can reach speeds of 125 mph. The combination induces strong wind downdrafts due to aerodynamic drag forces or evaporation processes. Microburst winds are more concentrated than downbursts and can reach speeds up to 150 mph. They can cause significant damage as both can last 5–7 minutes. They pose a big threat to aircraft landings and departures because of wind shear and detection difficulties.

Strong winds occasionally occur over the interior due to strong pressure differences, especially where influenced by mountainous terrain, but the windiest places in Alaska are generally along the coastlines. The west coast along Bristol Bay and the Bering Sea, the Aleutian Islands, Kodiak Island, the Alaska Peninsula, the Gulf of Alaska coast, and the Southeast Panhandle all experience wind storms on a fairly regular basis. Coastal areas that are framed by mountains, such as at Sitka, Craig, Ketchikan, and Juneau are particularly susceptible to high winds due to the channeling affect of the terrain as storms move inland.

Dangerously high winds, ranging from 70-101 mph, occurred throughout much of Southeast Alaska overnight on December 9 – 10, 1998 as a deep low pressure system curved northward along the coast. The windstorm caused widespread power and telephone outages, downed dozens of trees, and damaged homes, buildings, and airplanes.

A series of very strong low pressure systems battered the Aleutians November 2-5, 2000. During the storm, wind gusts reached an incredible 143 mph at the Dutch Harbor Spit. Hurricane force winds were recorded during the event at the following locations: 81 mph at Shemya, 82 mph at Atka, 75 mph at St. George, 81 mph at Cold Bay, 75 mph at Port Heiden, and 117 mph at King Cove. The community of King Cove sustained considerable wind damage to roofs, fences, and windows, and a boat was flipped by the storm. Approximately $50,000 of damage resulted.

On November 3, 2001, a very powerful storm developed in the northeastern Gulf of Alaska bringing hurricane force winds to several locations in the southeast Panhandle. Peak winds recorded during the event included 85 mph at Craig, 83 mph at Cape Spencer, 74 mph at the Ketchikan Harbor, and 74 mph in downtown Juneau. In Yakutat a peak wind of 84 mph was recorded, which is the highest wind ever recorded there. The high winds resulted in approximately $100,000 in property damage in the community of Yakutat.

Lightning
Image courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory (NSSL)

Thunderstorms & Lightning

Thunderstorms are caused by the turbulence and atmospheric imbalance that arise from combining:

- Unstable rising warm air.
- Lift.
- Adequate moisture to form clouds and rain.

They are composed of lightning and rainfall and can intensify into a severe thunderstorm with damaging hail, high winds, and flash flooding. A thunderstorm is considered severe if winds reach or exceed 58 mph, produces a tornado, or drops surface hail at least 0.75 inches in diameter.

Thunderstorms affect relatively small areas. The average thunderstorm is about 15 miles in diameter and lasts less than 30 minutes in any given location.

Lightning exists in all thunderstorms. It is caused by built-up charged ions within the thundercloud. Electricity is released which can be harmful to humans and can start fires when lightning connects with a grounded object.

Stages of Development

Developing - A towering cumulus cloud develops as air rises. The cloud extends to about 20,000 feet above the level of freezing temperatures. Usually there is little if any rain, but occasionally lightning occurs during this stage, which lasts about 10 minutes.

Mature - During this stage, the storm builds to heights of 40,000 feet or more. This is the most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes. The mature stage lasts an average of 10 to 20 minutes, but may last much longer.

Dissipating - Downdrafts begin to choke off the supply of air that feeds the storm; the storm stops building, loses height, and dissipates. Rainfall decreases in intensity, but some thunderstorms produce a burst of strong winds in this stage, and lightning remains a danger.

The thunderstorms that occur in Alaska are usually the single-cell or “pulse” variety. They usually develop from a combination of atmospheric instability and moisture; triggered by surface heating from the sun. These storms generally last only 20-30 minutes and do not usually produce severe weather. A pulse thunderstorm may rarely produce brief high winds, hail, or weak tornadoes. Multi cell thunderstorm and squall line tornadoes are rare in Alaska and super cell thunderstorms are almost unheard of here.

Wildfire is a much more common impact of thunderstorm activity in Alaska. BLM sensors positioned across the interior have located an average of 26,000 cloud-to-ground lightning strikes per year. Very active thunderstorm days may feature 2,000 to 5,000 lightning strikes, mainly occurring during the late afternoon hours during the end of June to the beginning of July. Many of these lightning strikes occur in the northern boreal forests of the Alaska interior occasionally leading to wildfires.

Alaska has a relatively low frequency of thunderstorms. In a typical year, Alaska has fewer than 20 days with thunderstorms, and they do not occur uniformly over the State. A majority of the storms occur over a preferred region between the Yukon and Tanana rivers during the warmest summer months. The most active thunderstorm area, at least in terms of cloud-to-ground lightning strikes, is the White Mountains area, north of Fairbanks. Other favored areas are the Yukon-Tanana uplands and flats, the Nowitna, Tetlin and Kantishna River Flats, the Ray Mountains, and the Kuskokwim Mountains.

<u>Types of Thunderstorms</u>

Single Cell - Short-lived storms (20 to 30 minutes) that cover a limited area (a few square miles).

Multicell - Multicell thunderstorms are an organized cluster of two or more single cell storms. Air flowing out of one storm fuels other storms, causing new storms to develop on the right or rear storm flank every 5 to 15 minutes.

Supercell - Supercells produce the most severe weather, last the longest (1 to 6 hours), and travel 200 miles or more. These storms can cause winds of more than 78 mph, giant hail (e.g., 2 inches), and tornado activity. Supercells produce updrafts of 56 to 112 mph that coexist with sustained downdrafts. Together, the updrafts and downdrafts act to extend the storm's duration.

Squall Lines - A line or band of active thunderstorms, a squall line may extend over 250 to 500 miles, may be from 10 to 20 miles wide, and consist of many laterally aligned cells that do not interfere with one another. The cells may be any combination of types (ordinary to severe, single cell to supercell). Squall lines may form along cold fronts, but often form as much as 100 miles ahead of an advancing cold front in the warm sector of an extratropical storm. They often trail a large, flat cloud layer that brings significant rain after the storms pass.

Thunderstorms are also periodically observed along the southern coastal areas, with a higher frequency along the eastern Gulf of Alaska coast between Cordova and Craig. Interestingly, these storms occur during the winter months as well as during summer. The risk of wildfire due to lightning strikes is much less prevalent in the coastal region than in the interior, because the frequency of storms is smaller and the climate is much wetter. Lightning caused injuries and deaths are unusual in Alaska, but certainly not unheard of. In 1986, a teenage girl was killed and three other people were injured near Tok when they took shelter under a tree. In 1993, a young man was injured by lightning while standing on a ball field in North Pole, Alaska.

A thunderstorm spawned tornado near Healy, AK

Hail

Hailstorms are a thunderstorm outgrowth in which ball or irregular shaped lumps of ice greater than 0.75 inches in diameter fall with rain. The size and severity of the storm determine the size of the hailstones. In Alaska, hailstorms are fairly rare and cause little damage, unlike the hailstorms in Mid-western states. The extreme conditions of atmospheric instability needed to generate damaging sized hail (greater than ¾ inch diameter) are highly unusual in Alaska. Small hail of pea-size is periodically observed.

Hail collecting during a thunderstorm. *Image courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory (NSSL)*

In August of 2000, an intense thunderstorm moved across the community of Sitka, dumping pea- to dime-sized hail over the downtown area. The hail covered the ground and plugged up storm drains causing minor street flooding until it melted.

Coastal Storms

Low pressure cyclones either develop in the Bering Sea or Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that tend to steer storms in the North Pacific Ocean toward Alaska from the fall through the spring. They often bring wide swathes of high winds and occasionally cause coastal flooding and erosion.

The intensity, location, and the land's topography influence the storm's impact. Another factor that influences the damage done to the shoreline is whether or not the shore ice is solid enough to protect against erosion and physical damage to community infrastructure.

Waves breaking on the beach in Nome during a 1902 storm
Image courtesy MSCUA, University of Washington Libraries, Hegg 1851

Fierce storm conditions do not have to be present to cause damage. Northwestern communities suffer from "Silent Storms" where high-water storm surges erode and undercut the banks melting the permafrost.

A series of storms struck the west coast of Alaska causing major coastal flooding November 11-13, 1974. Significant damage occurred in the communities of Deering, Shishmaref, Nome, Wales, Brevig Mission, Teller, Golovin, Elim, Koyuk, Shaktoolik, Unalakleet, St. Michael, Stebbins, Kotlik, Alakanuk, Scammon Bay, Sheldon Point, Hooper Bay and Kotzebue. Unalakleet was the hardest hit due to a combination of flooding and wind damage. Some portions of the City of Nome were less than 10 feet of water during the brunt of the storm.

An intense storm made land fall near Port Heiden, and coastal flooding occurred on Kodiak Island on January 20, 1980. The area sustained over $500,000 in damage: Kodiak Port facilities, toppled by high water and wave action; Port Lions, harbor facilities damages; Old Harbor, erosion and break water damage; Ouzinkie, harbor boardwalks damage, and Karluk and Ahkiok, private housing damages.

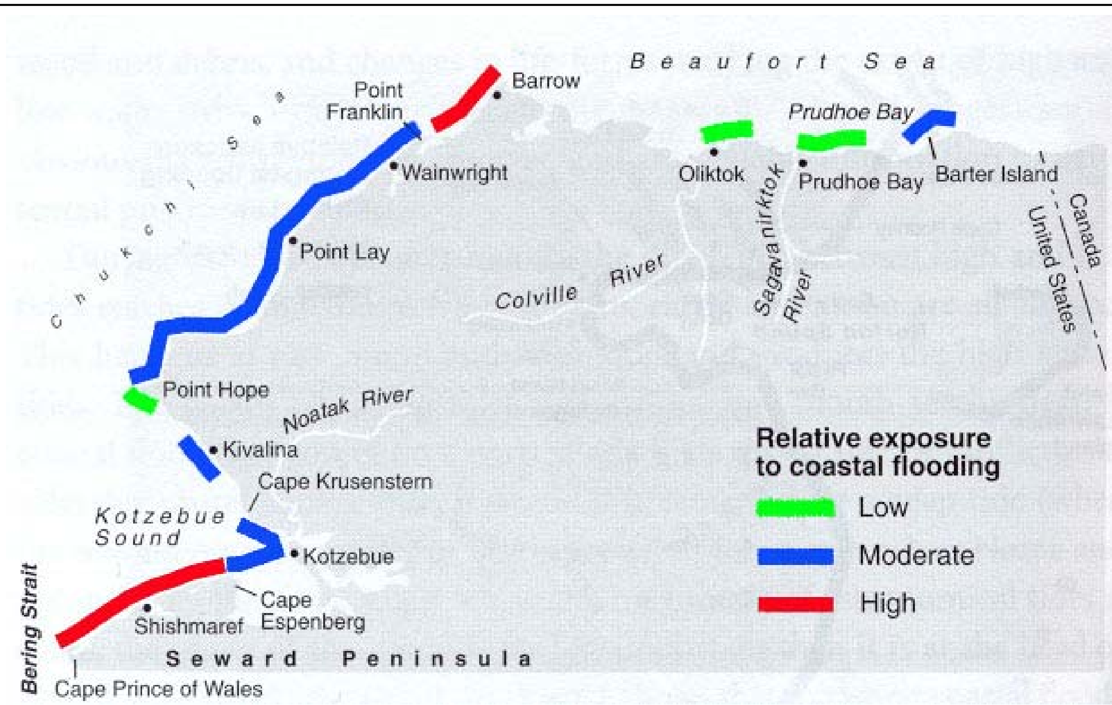
Storm Surge

Storm surges, or coastal floods, occur when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive-flooding water's force. The conditions that cause coastal floods also can cause significant shoreline erosion as the flood waters undercut roads and other structures. Storm surge is a leading cause of property damage in Alaska.

Waves washing houses off sand spit during a 1902 storm in Nome
Image courtesy of MSCUA, University of Washington Libraries, Hegg 1853

The meteorological parameters conducive to coastal flooding are low atmospheric pressure, strong winds (blowing directly onshore or along the shore with the shoreline to the right of the direction of the flow), and winds maintained from roughly the same direction over a long distance across the open ocean (fetch).

Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding. Several communities and villages along the Bristol Bay coast, the Bering Sea coast, the Arctic coast, and the Beaufort Sea coast have experienced significant damage from

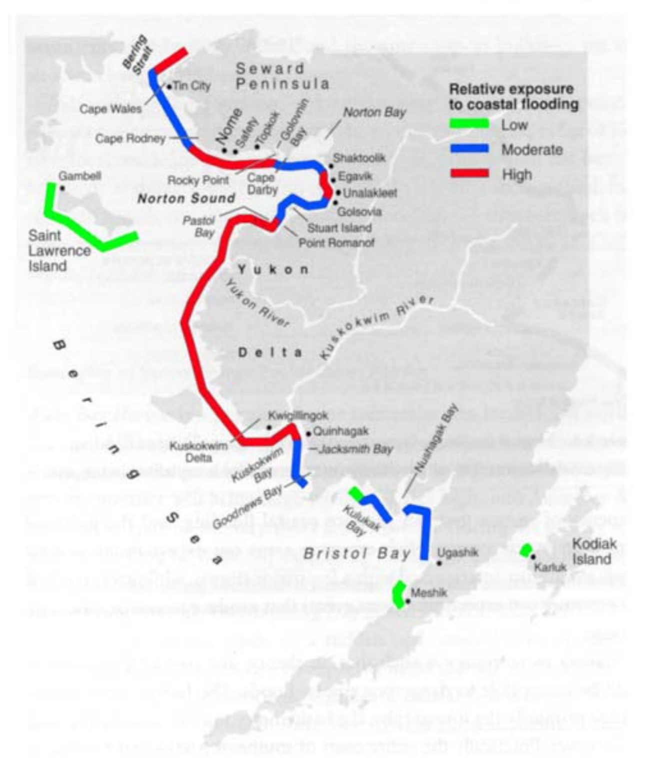


Areas subject to storm surge along the Arctic Ocean. Map adapted from Mason et. al., 1997. Low danger means flooding is infrequent and generally is not severe when it does occur. Moderate exposure means flooding may be expected once every 3 – 5 years and the magnitude of floods may be sufficient to cause beach erosion several years or more inland and damage to structures as much as six feet above normal high-tide and surf levels. High exposure means significant coastal flooding every two years or so and the flooding may cause significant beach erosion and damage to structures more than 100 years inland if these are situated within 10 feet or less of the normal high-tide and surf elevations.

coastal floods over the past several decades. Most coastal flooding occurs during the late summer or early fall season in these locations. As shorefast ice forms along the coast before winter, the risk of coastal flooding abates.

The Homer Spit has a moderate exposure to coastal flooding due to the consistent effects of erosion and the extraordinary tidal range in the region. Coastal flooding has occurred in the southeast Panhandle and on Kodiak Island, but the steep and rocky characteristics of the coastline make these events rare by comparison.

Coastal flooding and high winds caused $500,000 in damage on October 25-26, 1977 when a vigorous storm struck the eastern Aleutians. Buildings were blown from their foundation on Atka. Barges were temporarily beached near Port Heiden. Buildings were lost and wind damage occurred at King Cove. During the height of the storm, Adak reported 95-knot westerly winds and the ship "Vigilant" reported a pressure of 926.1 mb, which is a record low pressure for Alaska.



Areas subject to storm surge along the Bering Sea. Map adapted from Mason et. al., 1997.

The Bristol Bay coast experienced coastal flooding on August 17-18, 1980 as well. A strong low pressure system moved rapidly into Bristol Bay, and 30-foot tides were reported at Clark's Point. Several fishing boats were destroyed and homes and canneries were severely damaged at Ekuk and Clarks Point. Point Heiden also had boats and homes damaged. The Levelock dock washed away completely; a Dillingham fish processing plant sustained $100,000 of damage; and Naknek's New England Fish Company lost 5 boats, a dock with a crane, a mess hall and bunkhouses.

Minor coastal flooding occurred at Craig and Wrangell January 11, 1978 when a deep low moved inland over the southeast Panhandle and strong southwest winds impacted the area. At Craig, the sewage lift station and treatment plant were damaged and roads were washed out. The public dock at Wrangell was also damaged by the storm surge.

One of the most significant cases of coastal flooding occurred in Barrow on March 10, 1963. A deepening low pressure system moved eastward across the Arctic Ocean and Beaufort Sea, and a storm surge developed traveling west by northwest. Barrow experienced a surge of 11-12 feet, which damaged several homes, buildings, airplanes, and the electrical plant. Barrow's freshwater supply was also contaminated with seawater due to the flooding. Wainwright was 50% flooded by this event, and Point Lay and Barter Island also experienced coastal flooding.

Ivu

Ivu, also called an ice override, occurs when floating sea ice is pushed ashore by wind. It is fairly rare as it requires very specific weather and oceanographic conditions and shoreline topology, including gently sloping beaches to develop. They are usually associated with coastal storms and storm surge but can happen during calm weather. They usually occur in fall and early winter, but there have been reports of them occurring at other times. For example, it is believed that one struck Barrow in May of 1957. The ice usually over-rides the beach a few tens of feet inland and the entire event is generally less than an hour long.

They have been reported on the Seward Peninsula coast from Rocky Point to Cape Rodney, Gambell, the northwest coast of the Seward Peninsula, and the Arctic coast from Point Hope to Point Barrow.

In early December 1987, an ivu struck Nome. The ice cover in the area was only about two weeks old and had formed during calm weather so it was fairly flat and cohesive. One morning, light winds started in conjunction with the semimonthly maximum tides resulting in the ice riding up the beach and spilling over the seawall. By that afternoon, the event was over. Barrow can also be hard hit by ivu. In 1978, a 450-foot on shore movement was reported. There is evidence that other events in the area have gone a significant distance inland.

Climate Change

Climate changes are predicted to increase storm frequency and intensity to directly impact the extensive coastal infrastructure of Alaska by increased coastal flooding, inundation, and erosion; especially in the early winter months where sea ice has yet to form. In addition, sea level rise will exacerbate the flooding and erosion problem. Inland permafrost thaw will affect the State transportation infrastructure with collapsed roads, shifted railroad tracks, and building supports constructed on melting permafrost. Additional information is located in Section 4.1.11 and Appendices 32.

Hazard Vulnerability Analysis

HVA will be completed as data becomes available.

Existing Programs and Strategies

Storm Ready

StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.

To be officially StormReady, a community must:

Establish a 24-hour warning point and emergency operations center.

1. Have more than one way to receive severe weather forecasts and warnings and to alert the public.
2. Create a system that monitors local weather conditions.
3. Promote the importance of public readiness through community seminars.

4. Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.
5. Demonstrate a capability to disseminate warnings.

StormReady has different guidelines for different sized communities. Communities that would like to learn more about the StormReady program should contact their area National Weather Service Office in Juneau, Anchorage, or Fairbanks. Specific StormReady guidelines, examples, and applications also may be found on the Internet at www.nws.noaa.gov/stormready.

NWS - USCG "Operation Weather Blanket" Project
The National Weather Service and the U.S. Coast Guard 17th District formed a partnership in December 2000 to improve the dissemination of weather information throughout the Southeast, Prince William Sound, and Kodiak regions of Alaska. The project goal is to provide the Alaskan maritime community with reliable access to forecast and warning information by increasing the NWS broadcast footprint using low power transmitters located at selected Coast Guard VHF-FM communication sites (called high sites because of their strategic location on mountain peaks) to deliver a continuous weather broadcast.

By combining efforts, the USCG and NWS are improving weather product delivery to the public at a minimal cost. The completed project will continuously broadcast NWS products from 28 USCG high sites for less than $200,000. The transmitter locations will result in at least a 300% increase in broadcast coverage area and provide weather services to areas where previously there was no reception at all. Plans call for a multi-year phased installation schedule.

As of April 2002, seven new transmitters are operational, and Southeast communities like Elfin Cove, Funter Bay, and Pelican finally have dependable access to real-time warning information for severe weather, flooding, and tsunamis.

Hazard Mitigation Successes

Mitigation activities associated with the Public Assistance worksheet for the severe windstorm disaster DR-1461-AK secured roofing materials in the Mat-Su Borough. Additional buildings were identified and projects have been submitted for funding through the HMGP process to complete further mitigation. The projects are under review by FEMA and are anticipated to be approved.

Goals

1. Increase public education.

Mitigation Measures: Educational; Preventative

1.1. Objective: Conduct special statewide outreach/awareness activities, such as Lightning Safety Awareness Week, Winter Weather Awareness Week, Flood Awareness Week, etc.

Many people do not realize how dangerous extreme weather can be. Educating people about Alaska's weather hazards and ways to mitigate is vital.

1.1.1. Action: Host a minimum of four outreach events each year.

Lead: NWS
Support: DHS&EM, DCCED, DEC, DOT&PF,
Timeline: on-going

2. NOAA weather Radio/Communications

Mitigation Measures: Educational; Preventative

2.1. Objective: Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability.

2.1.1. Action: Create and pursue funding for PSA.

Lead: NWS
Support: DHS&EM, DCCED, DEC, DOT&PF,
Timeline: on-going

2.2. Objective: Add more stations to the NOAA Weather Radio (NWR) network in Alaska and promote the rebroadcast of NWR using alternative technologies.

2.2.1. Action: Contact Coastal radio stations to join the network and encourage information to be posted on agency web sites.

Lead: NWS
Support: DHS&EM
Timeline: 5 years

2.3. Objective: Encourage local emergency officials to employ redundant methods of receiving weather warnings and disseminating those warnings throughout the community.

2.3.1. Action: Contact EOC's for agreement to receive warnings via FAX, E-Mail, radio, telephone and to transmit to public in redundant methods.

Lead: DHS&EM
Support: NWS
Timeline: on-going

3. Monitoring

Mitigation Measures: Educational; Preventative

3.1. Objective: Expand use of all-season storm spotter networks by recruiting and training volunteers statewide**.**

3.1.1. Action: Host workshops in communities.

Lead: NWS
Support: local communities
T**imeline**: on-going

3.2. Objective: Expand weather monitoring networks through partnerships with other agencies -- precipitation gauges, anemometers, and other weather instruments.

3.2.1. Action: Gain funding to train agencies and purchase equipment.

Lead: NWS
Support: DSH&EM, local communities
Timeline: 3 years

4. Building Construction

Mitigation Measures: Educational; Preventative; Protection

4.1. Objectives: Encourage weather resistant building construction materials and practices.

Weather resistant construction material and building practices can help structures withstand weather events with minimal damage. For example, roofs can be braced and strapped to prevent damage during high winds, grounding buildings will reduce or eliminate lightning damage, constructing sloped roofs instead of flat roofs will prevent or reduce snow damage, etc.

4.1.1. Action: Show long term benefit to community leaders.

Lead: Fire Marshal's Office
Support: local communities
Timeline: on-going

4.2. Objective: Encourage the use of snow fences where feasible.

Heavy snow accumulation often forces road closures, sometimes for months at a time. Reducing snow drifting and depth helps road crews keep the roads open later in the fall and open it earlier in the spring (clear faster).

4.2.1. Action: Identify at-risk areas and test usefulness.

Lead: DOT&PF
Support: DPS, DHS&EM
Timeline: on-going

5. Expand the StormReady and TsunamiReady programs in Alaska by *completing* at least two joint, NOAA/NWS/State, community visits per year to encourage StormReady and TsunamiReady qualification.

Mitigation Measures: Educational; Preventative

5.1. Objective: Create safer communities for Alaska residents in coastal communities.

5.1.1. Action: Help coastal communities become TsunamiReady.

Lead: NWS
Support: DHS&EM, WC&ATWC
Timeline: on-going **(As of 2007 Anchorage, Wasilla, McGrath, Juneau, and Nome have all been declared StormReady, and the entire Iditarod Trail was declared StormReady with interaction between the NWS, local communities, and the Iditarod Executive Committee. In addition, the communities of Seward, Kodiak, Homer, and Sitka have been re-declared as being both TsunamiReady/StormReady.)**

Summary of local capabilities, goals and actions

Anchorage

Capabilities: planning, and education.

Goals: continued planning and education.

Juneau

Capabilities: planning and education.

Goals: continued planning and education.

Mat-Su Borough

Capabilities: include planning and education,

Goals: include adopting building codes to harden structures to include homes, public facilities, educate.

Seward and Homer

Capabilities: Tsunami Ready program, planning, zoning, and education.

Goals: continued planning, education and conduct exercises.

Statewide

Capabilities: Tsunami Ready program, planning and education.

Goals: NWS and DHS&EM will visit a minimum of two communities per year to encourage StormReady and TsunamiReady qualification (as appropriate). The interagency programs are volunteer based between local, State, and federal agencies. Involvement of each partner is essential to the communities' preparedness levels and the success of these readiness programs.

For more specified information about these areas, please refer to appendix 20.

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